PATENT SPECIFICATION

731,299

Inventor :—WILLIAM NORMAN KILNER.

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Index at Acceptance :—Class 35, A2(E9 : F).

COMPLETE SPECIFICATION.

Improvements relating to Dynamo Electric Machines.

We, METROPOLITAN-VICKERS ELECTRICAL COMPANY LIMITED, of St. Paul's Corner, 1-3 St. Paul's Churchyard, London, E.C.4, a British Company, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement :—

This invention relates to dynamo-electric machines and has an important application in large size turbo-alternators.

It is well known that one of the main factors limiting the output of a large dynamo-electric machine, such as a turbo-alternator, is the rise in temperature, this in turn depends upon heat dissipation. The limiting temperature rise is, of course, the temperature rise of any individual part or component, and hence it is desirable that adequate cooling be given to any portion of the machine that is prone to overheating.

The present invention is concerned with improving the cooling of the rotor conductors in such a machine and particularly the end portions thereof.

The present invention comprises a dynamo-electric machine in which the conductors constituting the rotor winding are of rectangular section and at least along the exposed parts projecting beyond the ends of the slots, formed with longitudinal passages and with inlet ports in the side (i.e. radial) surfaces of the exposed parts of the conductors remote from the ends of the slots, which ports communicate with said longitudinal passages so that cooling gas may flow along the longitudinal passages towards the slot-embedded portions of the winding.

Additional cooling in the end portions of the winding may be provided by radial passages extending right through the conductors and intersecting the longitudinal passages. The radial passages may either be in line with the side ports or else spaced therefrom by short lengths of longitudinal ducts.

The longitudinal passages may extend both along the exposed parts of the conductors and also along the conductors within the slots for a short distance from each end and then terminate and the intervening lengths of conductor within the slots may be substantially solid. The rotor may in addition be provided with sub-slots, i.e., axial ducts extending beneath the winding slots which are fed with gas at the ends and discharge through radial discharge passages which pass through the solid parts of the conductor winding.

The longitudinal conductor ducts may extend also along the embedded portions of the conductors or alternatively these may be made solid except for the radial passages between the sub-slots and rotor periphery.

The gas herein referred to may be air or hydrogen or other suitable gas.

In order that the invention may be more clearly understood, reference will now be made to the drawing accompanying the Provisional Specification, in which :—

Fig. 1 is a longitudinal radial section of a winding slot of a rotor, taken on the line I—I of Fig. 2 and showing the construction at the end of the core ; the section in this Figure is broken along the exposed parts of the conductors to show this arrangement more clearly ;

Fig. 2 is a sectional view of one of the winding slots taken on the line II—II of Fig. 1 ;

Fig. 3 is a perspective view of the exposed end turns of the winding ; and to the accompanying drawing in which :—

Figs. 4 and 5 are views similar to Fig. 3 showing modified ways of forming the end turns.

In the arrangement shown there are four

[*Price* 3*s*. 0*d*.]

Price 4s 6d

Price 35p

conductors in each slot indicated by the letters A, B, C, and D respectively. Each conductor comprises a pair of channel members 1 and 2, placed one over the other so as to form a longitudinal duct 3 between the two members. The individual conductors are separated by insulation strips 4 both within the slots and outside the slots. Metal wedges 5 hold the conductors in the slots.

In Fig. 2 the reference 6 indicates teeth located at either side of the slot respectively. The reference 8 indicates the main rotor core; 9 is a sub-slot, i.e. the longitudinal duct extending beneath the main slot. Radial discharge passages 10 extend through the conductors and slot wedges in each slot at spaced intervals along the core. Gas is fed into the conductor ducts 3 through inlet ports 11 formed in the sides of the conductors over the portions constituting the exposed end turns. The gas flows along the duct 3 and discharges from these through the radial discharge passages 10; in addition gas is fed into the ends of the sub-slots 9 and discharges out through the discharge passages 10. In Fig. 1, which shows the end of the rotor, the end two discharge passages 10 are blanked off from the sub-slots by an insulation strip 12, whereas for the remainder of the slots ports 13 are cut in the insulation strip 12, so that the sub-slots 9 can discharge through the passages 10.

The references 14 and 15 indicate the normal rotor end rings whilst 16 is an inlet to the sub-slot 9; the gas flow along the sub-slot can, for instance, be provided by a fan on the rotor shaft. If desired vertical passages can be formed through the end sections of the conductor so as to provide inlets for gas additional to the side ports 11.

It will be appreciated that whereas only four conductors per slot have been shown for simplicity, there will normally be appreciably more than this in actual construction.

Fig. 4 shows a modification of the arrangement of end turns shown in Fig. 3, in which, in addition to the longitudinal ducts 3 in the conductors and the side ports 11, there are provided radial passages 17. These radial passages extend through the stack of conductors, with the exception of the radially outermost conductor, i.e. the top conductor strip as shown in the Figure.

In the arrangement of Fig. 4 the radial passages 17 are shown in alignment with the side ports 11.

Fig. 5 shows an alternative arrangement in which the radial passages 17 are displaced from the ports 11 but communicate with them through intervening lengths of longitudinal duct 3.

Whilst in the arrangements shown the longitudinal ducts 3 extend throughout the conductors these ducts may, in some cases, be omitted in the embedded parts of the conductors which may be made solid excepting for the radial ducts 10.

What we claim is:—

1. A dynamo-electric machine in which the conductors constituting the rotor winding are of rectangular section and at least along the exposed parts projecting beyond the ends of the slots, formed with longitudinal passages and with inlet ports in the side (i.e. radial) surfaces of the exposed parts of the conductors remote from the ends of the slots, which ports communicate with said longitudinal passages so that cooling gas may flow along the longitudinal passages towards the slot-embedded portions of the winding.

2. A dynamo-electric machine as claimed in Claim 1, in which the said exposed end parts of the rotor conductors are formed with additional radial passages intersecting the longitudinal passages so as to communicate with the ports in the sides of the conductors.

3. A dynamo-electric machine as claimed in Claim 2, in which said radial passages intersect the longitudinal ducts at the same positions at which the side ports are located so as to provide direct communication.

4. A dynamo-electric machine as claimed in Claim 2, in which the radial passages are dispaced along the conductors from the side ports and communicate with the side ports through short lengths of longitudinal ducts.

5. A dynamo-electric machine as claimed in any one of the preceding claims, in which the longitudinal passages extend along the exposed parts of the conductor and also extend along the conductors within the slots for a short distance from each end and then terminate, and the intervening lengths of conductor within the slots are substantially solid, except for cooling passages extending radially through the conductors between supply ducts in the rotor core and discharge ports in the rotor periphery.

6. A dynamo electric machine as claimed in Claim 5 in which the duct supply in the core, which feeds the radial passages in the solid parts of the conductors, extends axially beneath the slots and is provided with inlet openings at each end of the core.

7. A dynamo electric machine constructed substantially as herein described with reference to Figs. 1, 2, and 3 of the drawing accompanying the Provisional Specification.

8. A dynamo electric machine having a rotor winding constructed substantially as herein described with reference to Fig. 4 or Fig. 5 of the accompanying drawings.

J. W. RIDDING,
Chartered Patent Agent,
162 Shaftesbury Avenue, London, W.C.2.
Agent for the Applicants.

PROVISIONAL SPECIFICATION.

Improvements relating to Dynamo Electric Machines.

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This invention relates to dynamo electric machines and has an important application in large-size turbo-alternators.

It is well known that one of the main factors limiting the output of a large dynamo electric machine such as a turbo-alternator is the rise in temperature, which in turn depends upon heat dissipation. The limiting temperature rise is, of course, the temperature rise of any individual part or component. The usual methods of cooling, such as blowing air through the machine, cool the external surfaces of the cores but may provide insufficient cooling for interior parts such as the embedded parts of the conductors themselves.

The present invention is concerned with improving the cooling of the rotor conductors.

The present invention comprises a dynamo electric machine in which the rotor conductors have longitudinal ducts for cooling gas with inlet ports in the side, i.e. radial faces of the exposed end turns of the winding and discharge passages in the embedded parts of the winding extending between the ducts and the rotor periphery.

The rotor may, in addition, be provided with sub-slots, i.e. axial ducts extending beneath the winding slots which are fed with gas at the ends, and discharge through the radial discharge passages.

According to a preferred arrangement the radial discharge passages which are located along the mid part, i.e. axially of the rotor, are fed from the sub-slots, and the discharge passages towards the ends of the rotor are fed through the conductor ducts.

The gas herein referred to may be air or hydrogen or other suitable gas.

In order that the invention may be more clearly understood reference will now be made to the accompanying drawing in which :

Fig. 1 is a longitudinal radial section of a winding slot of a rotor, taken on the line I—I of Fig. 2, and showing the construction at the end of the core ; the section in this Figure is broken along the exposed parts of the conductors to show this arrangement more clearly.

Fig. 2 is a sectional view of one of the winding slots taken on the line II—II of Fig. 1.

Fig. 3 is a perspective view of the exposed end turns of the winding.

In the arrangement shown there are four conductors in each slot indicated by the letters A, B, C, and D respectively. Each conductor comprises a pair of channel members 1 and 2, placed one over the other so as to form a longitudinal duct 3 between the two members. The individual conductors are separated by insulation strips 4 both within the slots and outside of the slots. Metal wedges 5 hold the conductors in the slots.

In Fig. 2 the reference 6 indicates teeth located at either side of the slot respectively. The reference 8 indicates the main rotor core ; 9 is a sub-slot, i.e. the longitudinal duct extending beneath the main slot. Radial discharge passages 10 extend through the conductors in each slot at spaced intervals along the core. Gas is fed into the conductor ducts 3 through inlet ports 11 formed in the sides of the conductors over the portions constituting the exposed end turns. The gas flows along the duct 3 and discharges from these through the radial discharge passages 10 ; in addition gas is fed into the ends of the sub-slots 9 and discharges out through the discharge passages 10. In Fig. 1, which shows the end of the rotor, the end two discharge passages 10 are blanked off from the sub-slots by an insulation strip 12, whereas for the remainder of the slots ports 13 are cut in the insulation strip 12, so that the sub-slots 9 can discharge through the passages 10.

The references 14 and 15 indicate the normal rotor end rings whilst 16 is an inlet to the sub-slot 9 ; the gas flow along the sub-slot can, for instance, be provided by a fan on the rotor shaft. If desired vertical passages can be formed through the end sections of the conductor so as to provide inlets for gas additional to the side ports 11.

It will be appreciated that whereas only four conductors per slot have been shown for simplicity there will normally be appreciably more than this in actual construction.

J. W. RIDDING,
Chartered Patent Agent,
162 Shaftesbury Avenue, London, W.C.2.
Agent for the Applicants.

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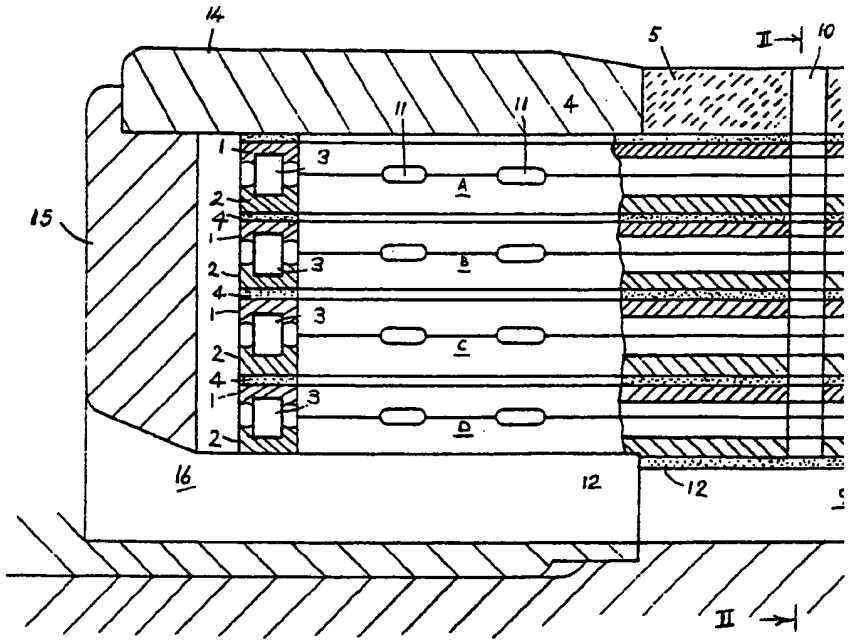

FIG. 1

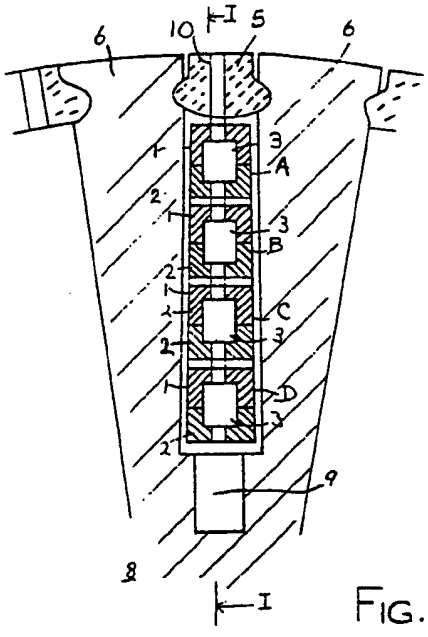

FIG. 2

731,299 PROVISIONAL SPECIFICATION
2 SHEETS

This drawing is a reproduction of the Original on a reduced scale.
SHEET 1

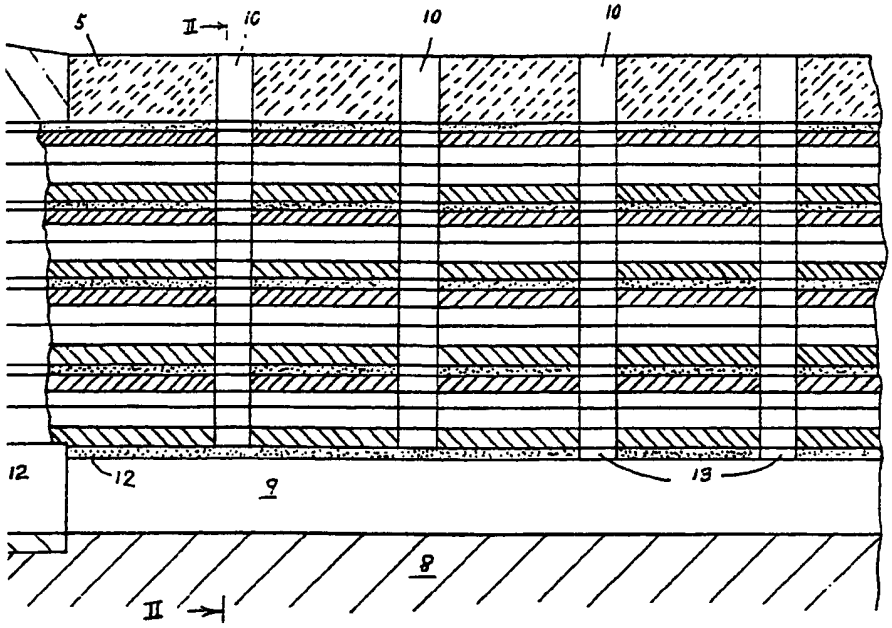

FIG. 1.

FIG. 2

731,299 PROVISIONAL SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEET 1

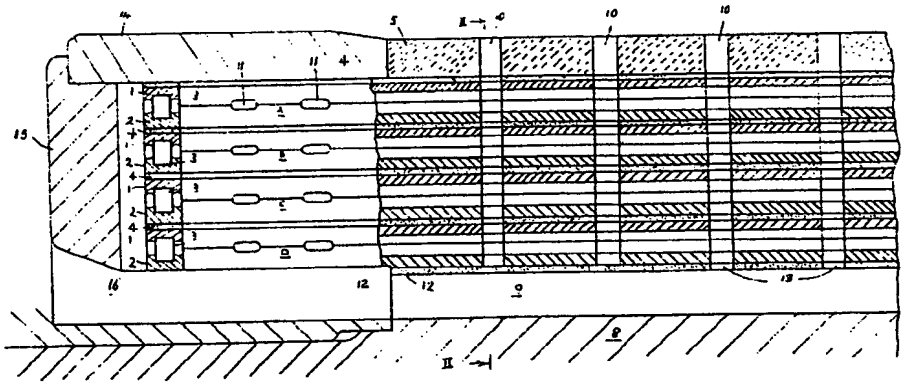

FIG. 1.

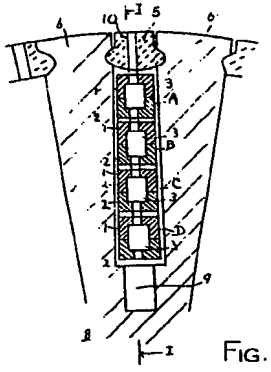

FIG. 2

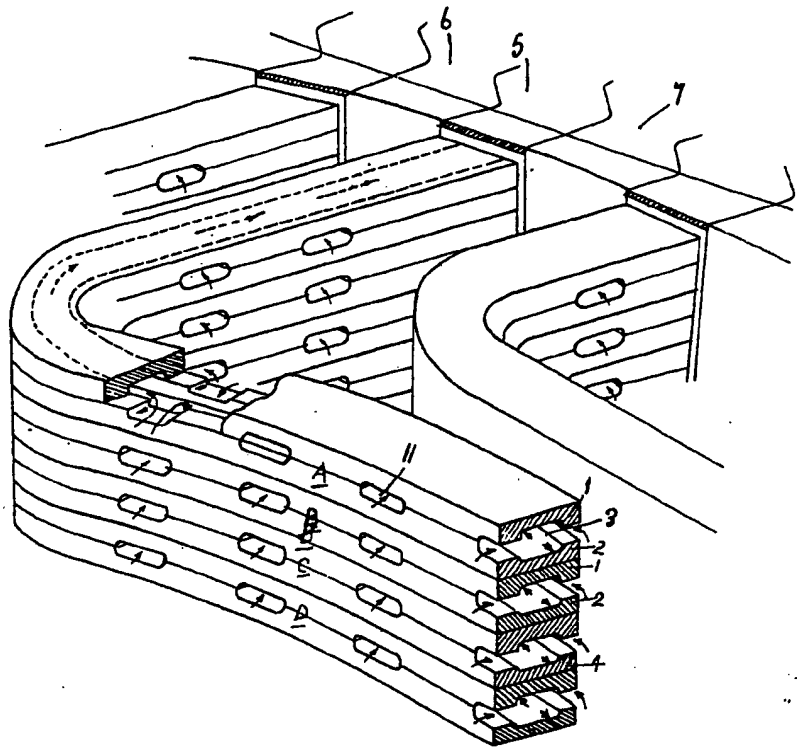

FIG. 3.

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1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

FIG.4.

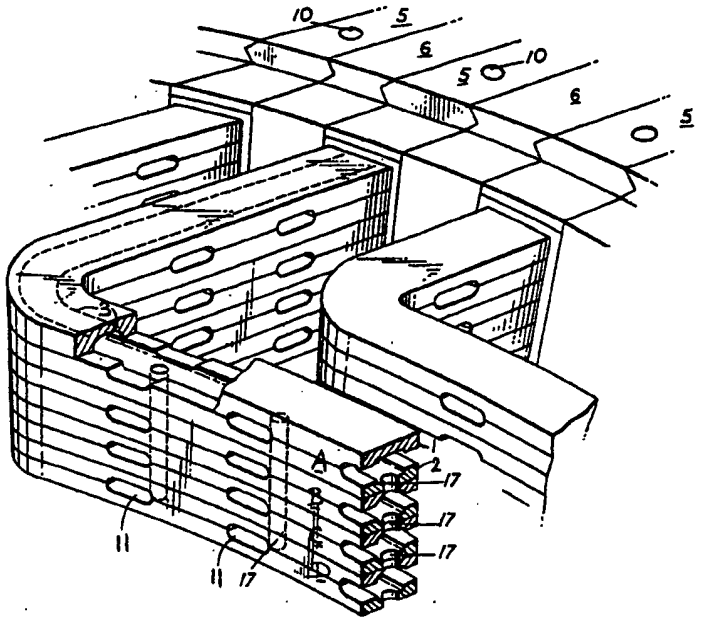

FIG.5.